Editorial

The future of the uniportal approach

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As the landscape of thoracic surgery continues to change at an unprecedented rate, we have seen the evolution of uniportal video-assisted thoracic surgery (U-VATS) transition from a novel technique as described in the early years of the last decade, to becoming the mainstay of thoracic procedures performed worldwide; especially within Asia. The continuing enthusiasm for reducing surgical access trauma is no doubt going to be paralleled with the evolving technology that is booming within the medical industry.

One of the key advantages of the uniportal approach in contrast to multiport VATS is the more ergonomic, 'top-down' perspective with the camera situated above the working instruments that enter the wound from below. This is in contrast to multiport VATS with the camera coming from below and behind the instruments. However, the already limited space is used up by the endoscope, restricting instrumentation and increasing instrument fencing. Despite improving surgical techniques to overcome these hurdles, there has been slow progress in bringing about more specialized equipment catered for the uniportal approach; rather, the majority of us have 'settled' with the instruments of the multiport era. Advancement of articulating, flexible VATS instruments like FlexDex (FlexDexSurgical, Brighton, Michigan, USA) and ArtiSential (LIVSMED Inc., Seongnam, Republic of Korea) have already been introduced to the market (1,2), and the widespread adoption of this equipment may facilitate the uniportal approach, particularly in more complex procedures, by increasing the maneuverability within a single, small incision. Development of more advanced multi-instrument equipment is also useful to increase the economy of motion throughout the procedure i.e., having different energy devices or graspers that can be switched around, along with suction capabilities. The refinement of wireless camera systems is also on the forefront of development of the uniportal approach. The ability to place the camera completely within the thoracic cavity and have it controlled wirelessly (either by the assistant or surgeon) is ideal to free up working space at the incision, and the developing magnetically anchoring guidance systems (MAGS) a promising candidate. To go further, one can consider the placement of multiple cameras that can be easily maneuvered extra-corporeally, i.e., magnetic, with the ability to switch between cameras for different viewing angles or for improved spatial awareness akin to the 360-degree surround view camera system in some motor vehicles that are enabled during parking. This can ultimately facilitate safe passage of instruments around critical structures during tissue dissection. The absence of an assistant to operate the visuals also opens the opportunity for development of 'automated' cameras with autonomous instrument tracking, which could provide a more streamlined procedure without adding to the surgeon's burden (3-5). Ultimately, the era of the uniportal approach may even lead to the 'uni-surgeon' era, made possible with smarter, more autonomous instruments and equipment that enhances the surgeon (6). However, as we progress, this technology will no doubt give way to robotics and the potential for higher degrees of autonomy.

Platforms like the da Vinci Single-Port (SP) (Intuitive Surgical Inc., Sunnyvale, CA, USA) has begun this revolution, bringing about flexible robotics into clinical use. Development in surgical robotics will be integral

in the advancement of uniportal thoracic surgery, as we have already witnessed the fusion of these two previously separate entities by Dr. Diego Gonzalez-Rivas utilizing the da Vinci Xi system (Intuitive Surgical Inc.) for uniportal pure robotic surgery (7). The effort would be in looking beyond our current conventional robotic systems, striving for smaller and more efficient platforms that can ultimately, as with the MAGS camera system, be placed completely within the thoracic cavity. Separate modular, flexible robots with different instruments or endo-staplers can be placed through a single incision at any point within the chest cavity, based on specific patient anatomy and the target structures; and can even be moved around intra-operatively to meet surgical needs as the procedure progresses.

We must however recognize that the patient population being faced by thoracic surgeons nowadays has also undergone transition. The era of smaller peripheral lung nodules and ground glass opacities have pushed aside the need for open thoracotomy for large pulmonary tumors, thanks to the rise in computed tomography screening programs and access to diagnostic scans by the general population. This has led to the need for more nuanced imaging techniques, coupled with specialized instruments and approaches such as electromagnetic navigation bronchoscopy or robotic bronchoscopy, to provide the range of diagnostic and even potential therapeutic options (8,9) within the hybrid operating theatre via the natural 'uniportal' passage of the airway. Undoubtedly the amalgamation of these approaches with uniportal approaches for limited and lung preserving resections, aided by bronchoscopic dye-marking or metallic marker placement for nodule localization, will be the way forward as more thoracic surgery transitions into image-assisted procedures (10). As these 'incision-less' bronchoscopic platforms mature, similar promise of procedural automation can be expected in allowing nodules to be reached by means of autonomous robotic bronchoscopy with developments in deep machine learning.

Looking further into the future, as trans-bronchial therapeutics become more advanced, this may allow therapy beyond energy ablation, including drug delivery directly into tumors, or even transbronchial lung resections with miniaturized instruments. In select lung diseases, the transition to natural orifice, or 'no-port' approach may be apparent. Certainly, if we were to entertain the idea of true robotic surgery, analogous to the aviation industry, perhaps fully automated procedures as a result of meticulous programming tailored to each patient and their procedure, will be the future.

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Footnote

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